EPA
United States
Environmental Protection
Agency

Using Assessment Endpoints to Link Management Goals to Numeric Criteria

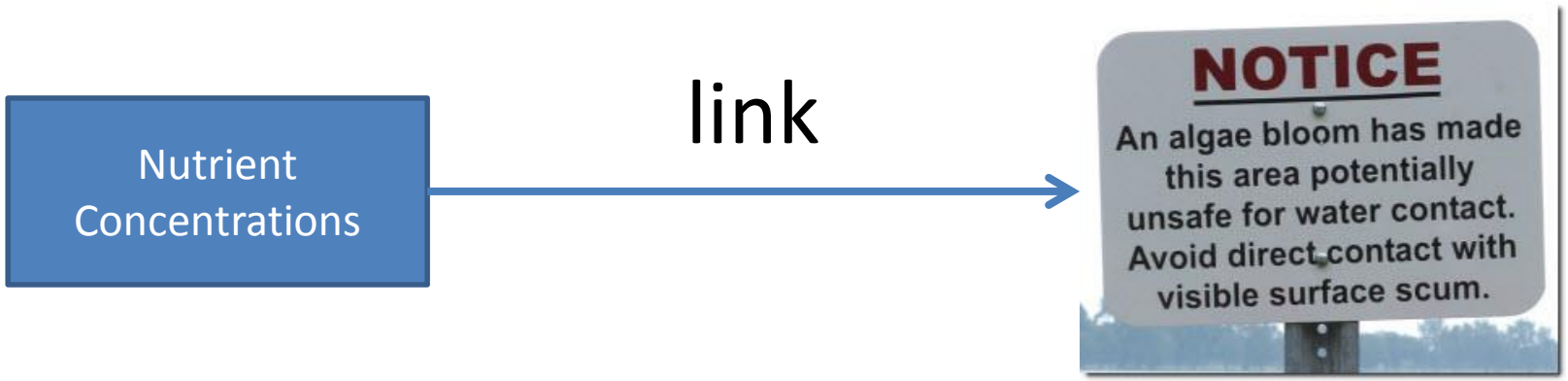
Goal: Provide a framework and examples of how to quantify and illustrate the linkage between effects of nutrient pollution and support of the designated use

Outline

- Background
- Identify assessment endpoints using a framework:
  - Define management goals
  - Select assessment endpoints and develop conceptual models
  - Analyze and characterize uncertainty
- Provide examples of how assessment endpoints can be linked to criteria derivation

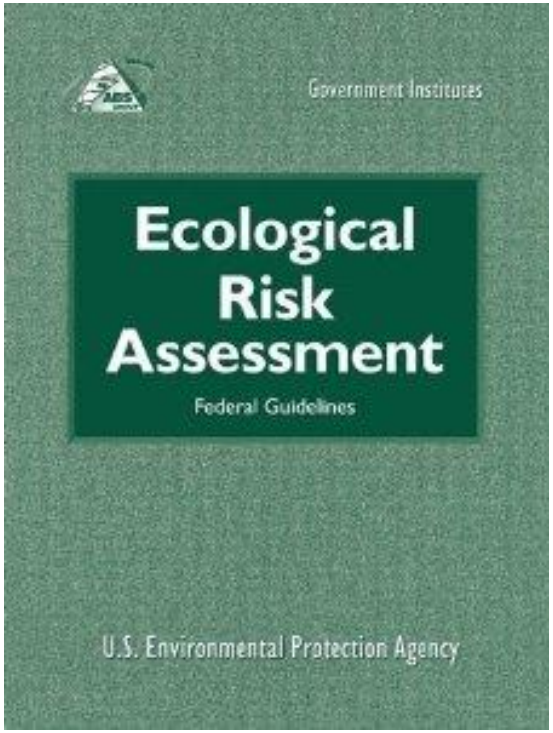
Background

- What we've learned:
  - Assessment endpoints can be used to link numeric nutrient criteria to protect aquatic life and human health.
- What we need:
  - A clear framework for developing and communicating defensible assessment endpoints and conceptual models of this linkage.



Background

- Ecological risk assessment has been used to address many environmental problems
- For more information, consult Guidelines for Ecological Risk Assessment (1998)



Terminology

Term	Definition
Management Goal	Narrative criteria or statement reflective of protecting a designated use
Assessment Endpoint	Ecological entity and its attributes to be protected to support designated use
Measure	Measurable attributes of an assessment endpoint
Water Quality Target	Numeric value that indicates attainment of the management goal

Ecological Risk Assessment Framework

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1. Planning

- Define the environmental issue of concern

2. Problem Formulation

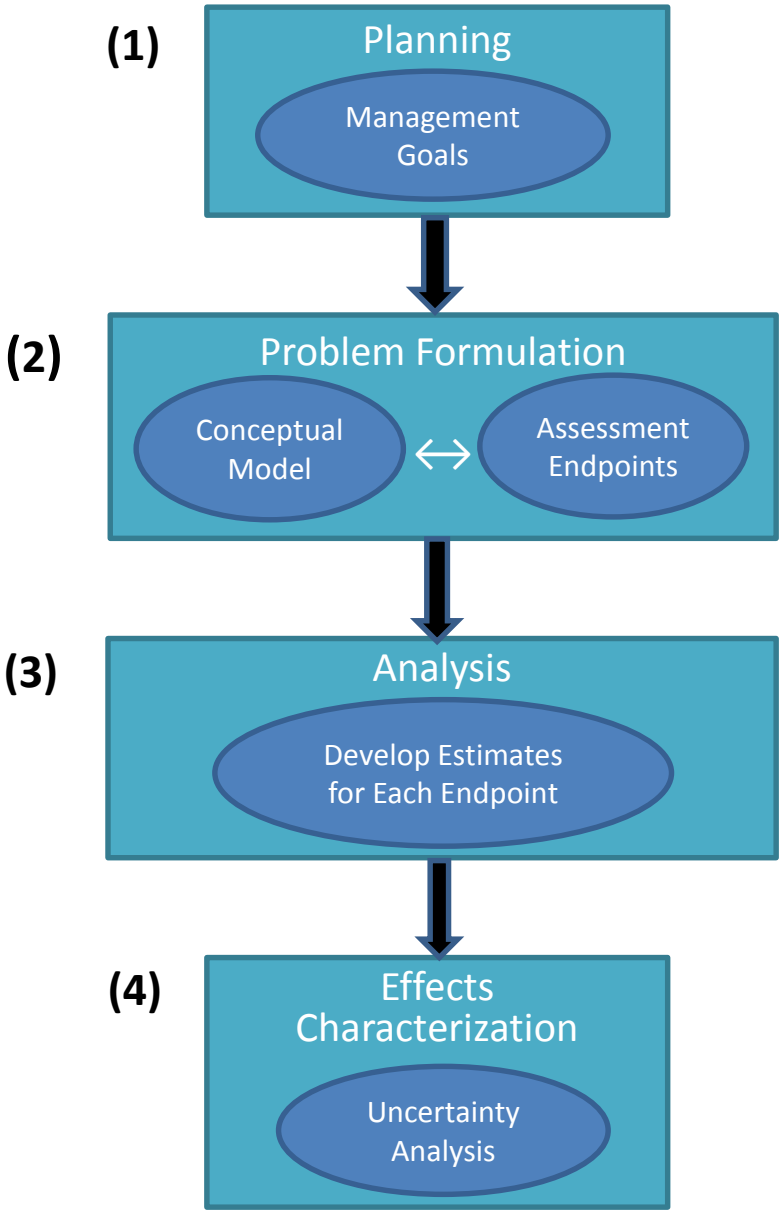
- Identify the ecological conditions representative of environmental improvement

3. Analysis

- Select an approach to quantify the issue of concern

4. Effects Characterization

- Description of uncertainty
- Typically post-criteria development



Step 1. Planning

- Define management goals:
  - Desired ecological condition
  - Water quality standard goal often is to protect aquatic life and human health uses
  - Can be narrative criterion or other statement reflecting aquatic life and human health use support
- Examples:
  - “Support propagation of fish and wildlife”
  - “Maintain a sustainable aquatic community”
  - “Prevent nuisance algal blooms”

Step 2. Problem Formulation

- Assessment endpoints are environmental values that define protection. They should be:
  - Ecologically relevant
  - Sensitive to nutrients
  - Relevant to management goals
- Remember, an assessment endpoint:
  - Provides ecological relevance and value to the management goals and designated use protection
  - Is central to conceptual model development
- Examples: Algal community structure or SAV distribution

"Assessment endpoints are explicit expressions of the actual environmental value that is to be protected, operationally defined by an ecological entity and its attributes" (*Guidelines for Ecological Risk Assessment*, USEPA 1998).

Step 2. Problem Formulation

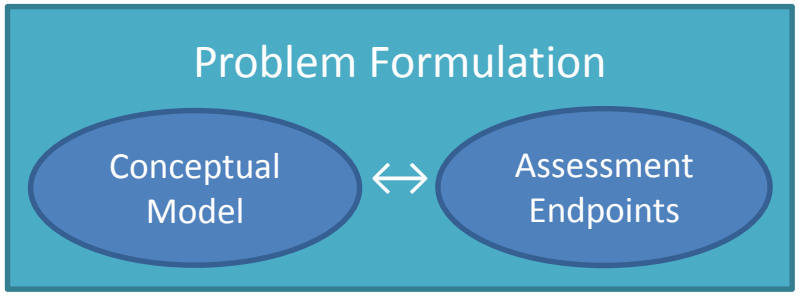
Selecting Endpoints

Is the endpoint sensitive to nutrients?

- How to determine if your endpoint is sensitive:
  - Change in primary productivity as nutrients increase
  - Increase in respiration rate with nutrient enrichment
  - Changes in plant community structure due to increases in nutrients (changes in abundance and richness)
- Ways to measure assessment endpoint sensitivity:
  - Chlorophyll-a (primary productivity)
  - Dissolved oxygen (respiration rate)
  - Species percent (changes in plant community structure)
- What factors affect sensitivity:
  - Fate/transport and retention of nutrients
  - Presence of other stressors or natural disturbances
  - Residence time
  - Response time lags

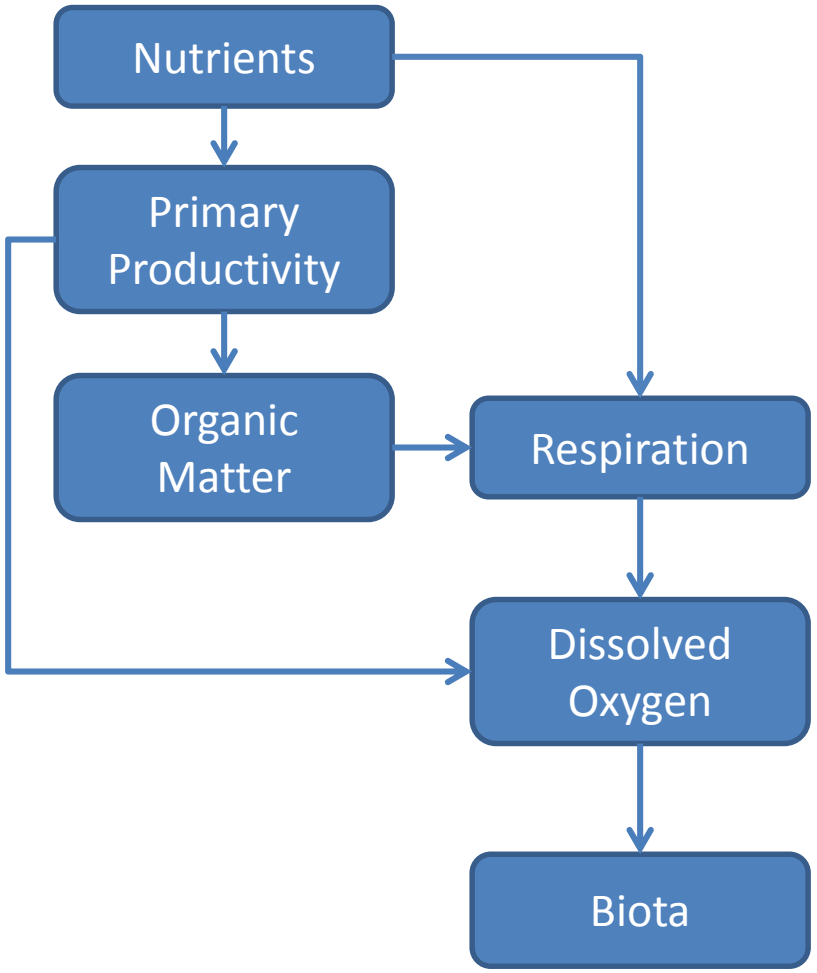
Step 2. Problem Formulation

- Define clear assessment endpoints that reflect management goals or value statements. For example:
  - Management goal: Protect aquatic life
  - Assessment endpoint: Dissolved oxygen (DO)
  - Measure: DO concentration to support aquatic life
  - Water quality target: Daily water column average of 5 mg/L
- Develop a conceptual model linking assessment endpoints to nutrients



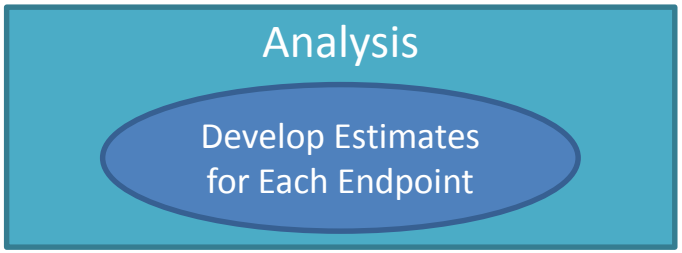
Step 2. Problem Formulation

A conceptual model is a ***visual representation*** of key relationships between nutrients and assessment endpoints.



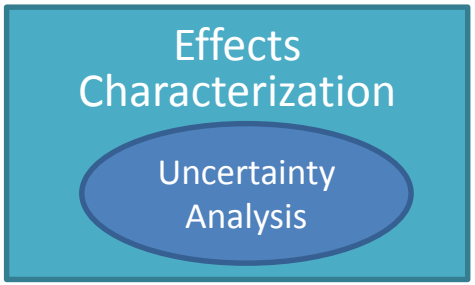
Step 3. Analysis

- Select an approach to derive numeric criteria
- Based on the type and amounts of available data, EPA recommends the following general approaches to derive numeric criteria:
  - Reference condition approach
  - Stressor-response approach
  - Mechanistic modeling
- Compute criteria



Step 4. Effects Characterization

- Evaluate the computed criteria
  - Sensitivity of nutrients to responses
  - Uncertainty associated with computed criteria



Key Concepts

- Translating management goals into assessment endpoints
- Using assessment endpoints to describe causal linkages between nutrient enrichment and biological condition

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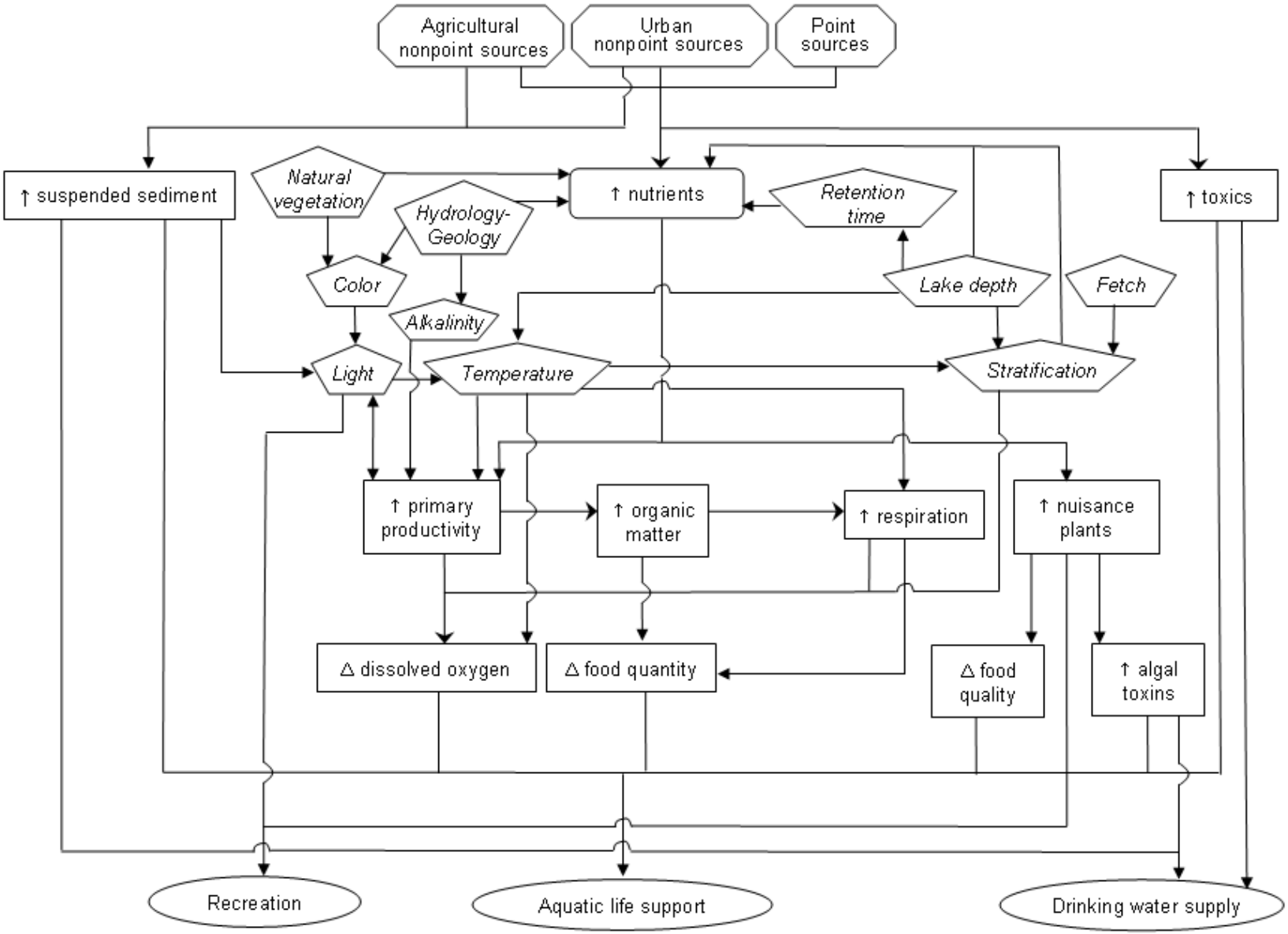
Lake Example

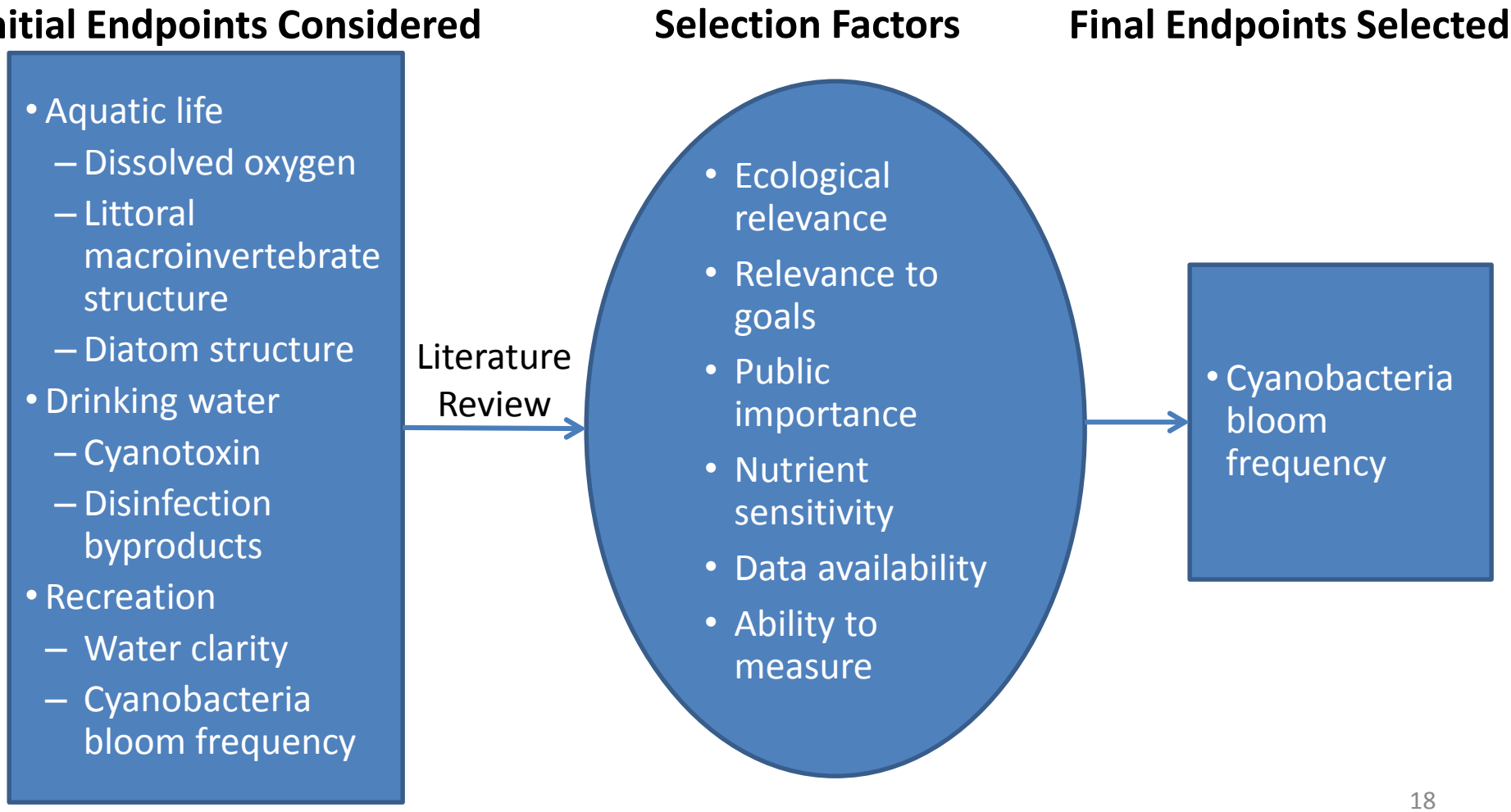
Linking Endpoints to Criteria Derivation
A Lake Example

- Management goal:
  - *Surface waters (except wetlands) must be free from substances attributable to human-caused point source or nonpoint source discharge in amounts which produce color, odor, other conditions in such a degree as to create a nuisance or harm existing beneficial uses or impart any undesirable taste to significant edible aquatic species or to the water; or produce a predominance of undesirable aquatic life.*
- Refined management goal: Algal bloom prevention

Lake Conceptual Model



Linking Endpoints to Criteria Derivation
A Lake Example



Identifying Assessment Endpoints for Numeric Nutrient Criteria Derivation

Lake Example

Management Goal: *Surface waters (except wetlands) must be free from substances attributable to human-caused point source or nonpoint source discharge in amounts which:*

- *produce color, odor, other conditions in such a degree as to create a nuisance or harm existing beneficial uses or impart any undesirable taste to significant edible aquatic species or to the water; or produce a predominance of undesirable aquatic life.*

Refined Management Goal	Assessment Endpoints	Measure	Water Quality Target
Balanced chlorophyll-a levels to support aquatic life	Algal biomass	Chlorophyll-a concentrations	Warm-water lakes: 8 – 25 ug/L Cold-water lakes: 2.5 –8 ug/L

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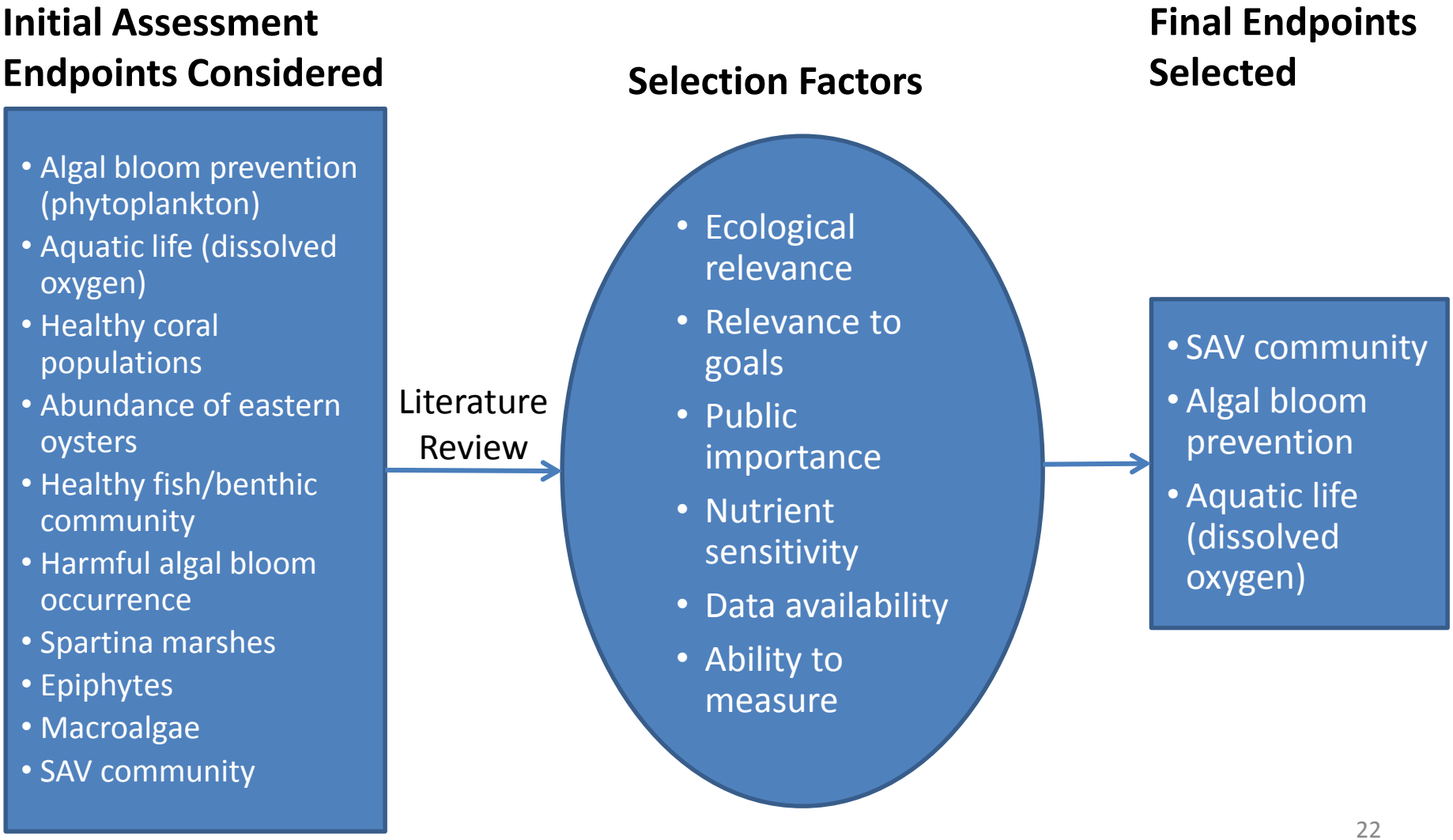
Estuarine Example

Linking Endpoints to Criteria Derivation: An Estuarine Example

- Management goal
  - *In no case shall nutrient concentrations of a body of water be altered so as to cause an imbalance in natural populations of flora and fauna.*
- Refined management goals: (1) Maintenance of SAV community, (2) Maintenance of balanced algal population, and (3) Maintenance of aquatic life

Linking Endpoints to Criteria Derivation: An Estuarine Example



Identifying Assessment Endpoints for Numeric Nutrient Criteria Derivation

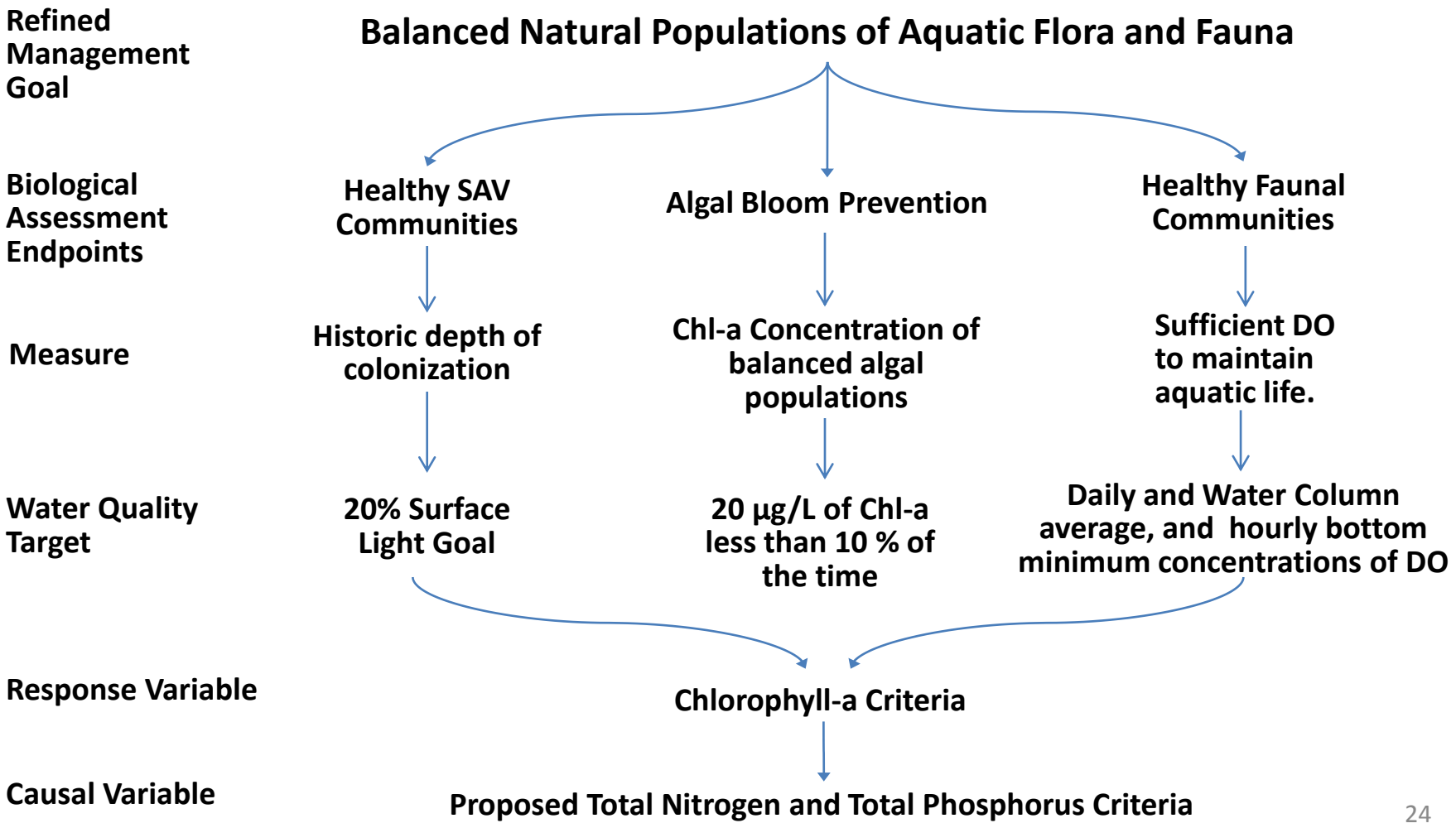
Estuary Example

Management Goal: *In no case shall nutrient concentrations of a body of water be altered so as to cause an imbalance in natural populations of flora or fauna.*

Refined Management Goal	Assessment Endpoint	Measure	Water Quality Target
Maintenance of SAV	SAV	Historic depth of SAV colonization	20% light attenuation
Maintenance of balanced algal population	Algal bloom prevention	Chlorophyll-a concentrations associated with balanced algal populations	Chlorophyll-a concentrations must not exceed 20 µg/L more than 10 percent of the time
Maintenance of aquatic life	Dissolved oxygen (DO)	Sufficient DO to maintain aquatic life	• Minimum allowable DO of 4.0 mg/L as a water column average 90 percent of the time • Daily average DO of 5.0 mg/L as a water column average 90 percent of the time • Minimum 3-hour average DO of 1.5 mg/L in the bottom two layers of an estuary segment

Linking Endpoints to Criteria Derivation
An Estuarine Example

Linkage Model



Lessons Learned

- Ecological risk assessment framework is a valuable tool to derive criteria based on assessment endpoints and conceptual models
- Assessment endpoints clarify what is being protected; conceptual models illustrate the linkages between nutrients and what is being protected
- The most sensitive assessment endpoints should be used to derive the nutrient criteria
- It is possible to identify many assessment endpoints, but there may not be scientific information available to derive numeric criteria for each endpoint